APPENDIX G
AN ASSESSMENT OF CHANNEL ALTERATIONS, STREAM BANK ALTERATIONS, AND CHANNEL ENCROACHMENT ALONG THE ST. REGIS RIVER

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Methods

Channel Alterations, Stream Bank Alterations and Channel Encroachment

Stream channel and bank alterations and channel encroachment associated with construction and maintenance of two highways and two railroads are suspected to have influenced the hydrology, sediment transport capacity, water quality, and aquatic habitat features of the St. Regis River. This project attempted to evaluate and quantify stream alterations along the St. Regis River and to identify key impact areas and causes. For purposes of this investigation, stream channel alterations are defined as the straightening of meanders or cutting through of meander curves with a new channel of less distance than the original. Stream bank alterations are defined as structural practices, such as riprap, jetties and dikes, used in an attempt to stabilize stream banks. Channel encroachment is defined as an unnatural confinement or constriction of the stream channel, and an accompanying loss of the stream's access to its natural floodplain.

Stream reaches along the St. Regis River were selected using 1996 orthophoto quads and analyzed using 1993 aerial photographs of the river corridor. Stream reach selection was based on valley type, land-use activities, natural breaks such as tributary confluences, and man-made breaks such as bridges and towns. A total of 10 reaches were delineated along the St. Regis River progressing upstream from its confluence with the Clark Fork River (**Table G-1**).

The vast majority of alterations along the St. Regis River were found to be associated with the placement of riprap along the stream banks. This project evaluated the length of stream banks impacted by riprap and encroachment using a visual assessment procedure. In addition, Interstate 90 construction plans obtained from the Montana Department of Transportation (MDT) were used to identify and quantify stream channel alterations specifically associated with the interstate highway project, along with the length and quantity of riprap added during highway construction.

Linear extent of riprap was measured on the 1996 orthophoto quads with 500-foot increment mid-channel stationing, beginning at the Clark Fork River confluence and extending upstream to the river's headwaters at St. Regis Lake. Channel impacts associated with Interstate 90 were compared to preexisting impacts associated with two railroads by examining aerial photographs from 1963-64, 1993, 1996, and 2000, together with the MDT construction plans for Interstate 90. St. Regis River tributary features and evidence of channel alterations were also assessed.

Table G-1. St. Regis River reach delineations

Reach	Description	Mile	Length	Stationing	Length
1	Clark Fork River to Twomile Creek	0 - 4.4	4.4	0 - 23,300	23,200
2	Twomile Creek to Ward Creek	4.4 - 8.1	3.7	23,200 - 42,500	19,300
3	Ward Creek to Twelvemile Creek	8.1 - 13.0	4.9	42,500 - 68,500	26,000
4	Twelvemile Creek to Deer Creek	13.0 - 17.3	4.3	68,500 - 91,500	23,000
5	Deer Creek to Haugan	17.3 - 21.6	4.3	91,500 - 114,000	22,500
6	Haugan to Saltese	21.6 - 26.3	4.7	114,000 - 138,500	24,500
7	Saltese to Taft	26.3 - 30.7	4.4	138,500 - 162,100	23,600
8	Taft to Hanaker Creek	30.7 - 33.9	3.1	162,100 - 178,500	16,400
9	Hanaker Creek to Northern Pacific Railroad Grade	33.9 - 37.3	3.5	178,500 - 196,700	18,200
10	Northern Pacific Railroad Grade to St. Regis Lake	37.3 - 39.9	2.6	196,700 - 210,500	13,800

Reaches delineated on the 1996 orthophoto quads were superimposed onto the 1963-64 and 2000 aerial photos. A Tamaya Super Planix β digitizing area-line meter was used to measure sinuosity of the St. Regis River channel from the 1963-64 (scale 1:20,000) and 2000 (scale 1:15,840) aerial photographs. Channel slope was determined using elevation data taken from the 2000 National Geographic Montana Seamless USGS Topographic Maps on CD-ROM (www.topo.com).

Results and Discussion

Channel Alterations, Stream Bank Alterations and Channel Encroachment
This analysis showed an extensive amount of stream channel alterations, stream bank alterations, and channel encroachment along the nearly 40-mile length of the St. Regis River. Development of a transportation corridor in the St. Regis River drainage has included the construction of the Chicago-Milwaukee-St. Paul and Northern Pacific railroads, U.S. Highway 10 and, most recently, Interstate 90 in the early 1980s. An analysis performed by the Montana Fish and Game Commission in 1963 found 17.9 miles of riprap along the banks of the St. Regis River, and 5.4 miles of relocated channel that removed natural meanders, and caused a loss of 0.9 miles of total river length. This report indicated that as much as 68 percent of the entire St. Regis River had been altered prior to the construction of Interstate 90 (Alvord and Peters, 1963). A report by the Superior Ranger District of the Lolo National Forest addressing probable impacts of the construction of Interstate 90 on the St. Regis River upstream of Saltese predicted an additional 1,900 feet (0.4 miles) of stream would be lost due to channel alterations (Howse 1969).

The current analysis indicates the presence of approximately 15.2 miles of riprap along the St. Regis River, with 10.5 miles along the river left bank and 4.7 miles along the river right bank. Collectively, about 26 percent of the river left bank is lined with riprap, while riprap covered about 12 percent of the right bank (**Table G-2, Figure G-1**). The majority of riprap used in stabilizing stream banks adjacent to Interstate 90, which generally parallels the north side of the river, was located along the river left bank. The majority of the riprap installed to protect the railroad is located along the river right bank. A total of 7.4 miles of riprap are associated with Interstate 90, while 7.8 miles of riprap are related to the construction and maintenance of Highway 10 and the railroads (**Table G-3**).

Table G-2. Linear estimates and percentages of St. Regis River stream banks altered by the placement of blanket rock riprap

Reach No.	Reach Length (feet)	River Left (feet)	%	River Right (feet)	%	Total Alterations (feet)	Total Alterations (%)
1	23,200	4,900	21	3,400	15	8,300	18
2	19,300	6,300	33	2,600	13	8,900	23
3	26,000	11,500	44	3,200	12	14,700	28
4	23,000	2,200	10	0	0	2,200	5
5	22,500	6,800	30	2,700	12	9,500	21
6	24,500	7,700	31	3,800	16	11,500	23
7	23,600	7,100	30	6,600	28	13,700	29
8	16,400	5,800	35	0	0	5,800	18
9	18,200	3,000	16	2,400	13	5,400	15
10	13,800	0	0	0	0	0	0
Total	210,500	55,300	26	24,700	12	80,000	19
	39.9 miles	10.5 miles		4.7 miles		15.2 miles	

The impacts of stream channel alterations, stream bank alterations, and stream channel encroachment due to the development of the transportation corridor are found to vary in intensity along the length of the St. Regis River (**Table G-2, Figure G-1**) and by cause (**Table G-3**).

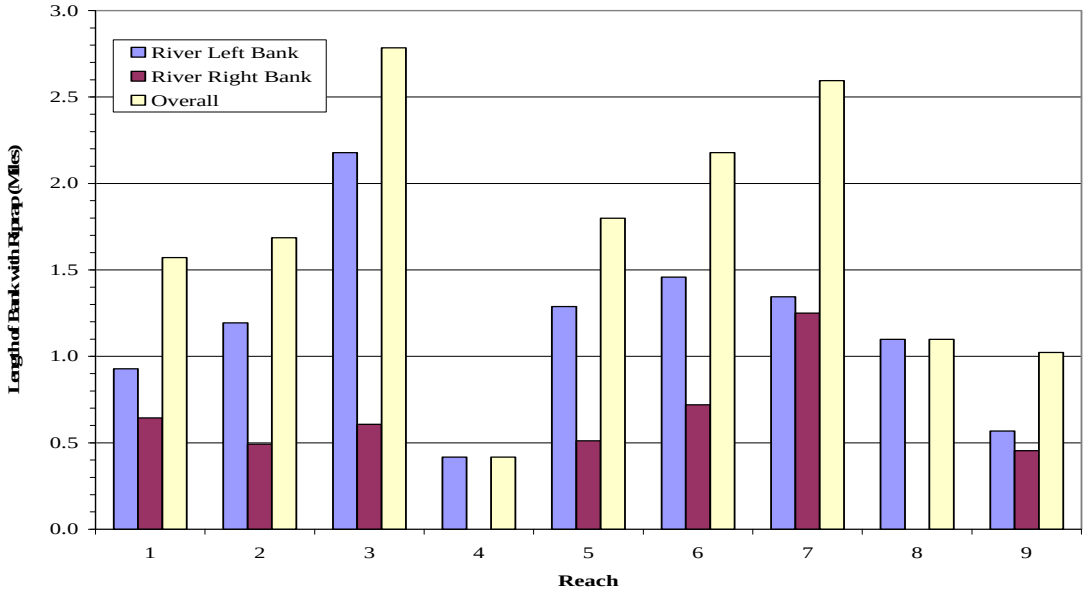

Figure G-1. Linear estimates of the length of St. Regis River stream banks altered by the placement of blanket rock riprap

Reach 1 is heavily impacted by the construction of Interstate 90 with 18 percent of all stream banks lined with riprap. Reach 2 appears to retain extensive impacts from Highway 10 and the railroads, as does Reach 3, with 23 percent and 28 percent of the banks riprapped, respectively. Both of these reaches are also heavily impacted by the construction of Interstate 90. There is a 2,000-foot section of channel alteration in Reach 3 between Drexel and Ward Creek where the stream channel was relocated during the construction of Interstate 90. Reach 4 is the least impacted reach of the St. Regis River within the transportation corridor and could serve as a

reference reach. Five percent of Reach 4 is lined with riprap, four percent of which was added during the construction of the railroads and Highway 10. Reach 5 is heavily impacted by Interstate 90 relative to stream bank alterations (19 % of all banks), while the major stream bank impacts in Reach 6 are caused by the railroads and Highway 10 (19%).

There is a 6,800-foot section of channel alteration within Reach 5, extending from the Big Creek Road Bridge downstream beyond the Big Creek confluence, where several meander curves have been cut off.

Reach 7 is highly impacted by both the railroad (17%) and Interstate 90 (12%), with a 10,000-foot section containing three separate channel alterations consisting of meander curve cut offs. Reach 8 is primarily impacted by riprap associated with the Interstate, with a total of 13 percent of the reach so affected by this source. Reach 9 is impacted relatively equally by both the railroad (8%) and the Interstate (7%), while Reach 10 is located outside the zone of influence of either Interstate 90 or the railroads and Highway 10.

Table G-3. Linear estimates and percentages of St. Regis River stream bank alterations (blanket rock riprap) associated with the construction of Interstate 90 or U.S. Highway 10 and the Chicago-Milwaukee-St. Paul and Northern Pacific Railroads

Reach No.	Reach Length	I-90 Alterations (right plus left banks)	%	Hwy10/RR Alterations(right plus left banks)	%
1	23,200	6,100	13	2,200	5
2	19,300	3,800	10	5,100	13
3	26,000	6,000	12	8,700	17
4	23,000	300	1	1900	4
5	22,500	8,400	19	1,100	2
6	24,500	2,300	5	9,200	19
7	23,600	5,500	12	8,200	17
8	16,400	4,200	13	1,600	5
9	18,200	2,400	7	3,000	8
10	13,800	0	0	0	0
Total	210,500	39,000	9	41,000	10
	39.9 miles	7.4 miles		7.8 miles	

The relative degree of impact resulting from St. Regis River stream bank alterations can be summarized by stream reach and for the river as a whole (Tables 2 and 3). For purposes of this discussion, a relatively low level of impact from stream bank alterations is defined as 0-10 percent of a given reach's total bank length (both banks) containing riprap. A moderate level of impact is defined as 11-25 percent of all banks containing riprap, while reaches having more than 25 percent of all banks with blanket rock riprap are considered to be heavily impacted from stream bank alterations. Applying this scale to the St. Regis River indicates that Reaches 1, 3, 5, 7 and 8 are moderately impacted by riprap associated with Interstate 90, while Reaches 2, 3, 6, and 7 are moderately impacted by stream bank alterations resulting from a combination of the railroads and Highway 10. It is important to note here that preexisting riprap associated with the construction of the railroads and Highway 10 is seen to provide a dual benefit of protecting Interstate 90 in some sub-reaches of the river. Interstate 90 minimally impacts Reaches 2, 4, 6,

and 9, while Reaches 1, 4, 5, 8, and 9 are minimally impacted by the railroad. Reach 10 is unaffected by either Interstate 90 or the railroads and Highway 10.

On a river-wide basis, cumulative stream bank impacts resulting from both Interstate 90 and the earlier development of the transportation corridor can be classified as having a moderate level of impact (19 % of all banks affected), based on the previously described classification system. Individual reaches, including 3 and 7, have sustained heavy impacts (28 and 29 %, respectively). Reaches 1, 2, 5, 6, 8, and 9 have moderate impacts associated with stream bank alterations, while reaches 4 and 10 have minor or no impacts (**Table G-2**).

If we consider that the presence of riprap along either bank of the stream can negatively affect the proper functioning of the channel on a site-specific as well as river-wide basis, the St. Regis River has sustained a greater degree of impact. Approximately one-third of the entire 40-mile length of the St. Regis River has experienced stream bank alterations in the form of rock riprap placement along at least one of its stream banks (**Table G-4**). Individual stream reaches ranged from 10 to 58 percent of at least one bank with riprap, except Reach 10, which is unaffected. Approximately four percent of the St. Regis River has both banks riprapped, with individual reaches ranging from less than one to nearly 15 percent of both banks containing rock riprap.

Table G-4. Linear estimates and percentages of the St. Regis River with blanket rock riprap present along one or both stream banks

Reach No.	Reach Length (feet)	Riprap present on at least one bank	%	Riprap present on both banks	%
1	23,200	8,000	34	300	1.3
2	19,300	8,500	44	100	0.5
3	26,000	14,500	58	200	0.8
4	23,000	2,200	10	0	0.0
5	22,500	8,700	39	800	3.5
6	24,500	10,100	41	1,400	5.7
7	23,600	10,200	43	3,600	15.0
8	16,400	5,800	35	0	0.0
9	18,200	3,400	19	2,000	10.9
10	13,800	0	0	0	0.0
Total	210,500	71,400	34	8,400	3.9
	39.9 miles	13.5 miles		1.6 miles	

Development of the transportation corridor has clearly impacted the St. Regis River by confining the channel and reducing channel sinuosity and length in localized areas. However, an analysis of changes in channel slope and sinuosity from 1963-64 to 2000 for the entire length of each of the 10 study reaches of the St. Regis River failed to indicate substantial differences. This may be primarily due to the fact that most channel impacts occurred prior to 1963-64 and the construction of Interstate 90 in the 1980s. The other factor is that localized channel changes, like those associated with the Interstate 90 construction described earlier, tend to become less pronounced when averaged over the 2.6 to 4.9 mile lengths of the study reaches.

The Lolo National Forest predicted that construction of Interstate 90 would cause a decrease in the number and quality of pools, a decrease in bank cover where riprap encroached on the

channel, and a loss of bank stability as water was forced into the opposite bank. Channel gradient and water velocity were also predicted to increase (Howse 1969). The mean channel sinuosity was measured at 1.2 in both 2000 and 1963-64, while the 2000 mean channel slope was 1.4% (**Table G-5**).

Table G-5. Channel sinuosity, slope and vertical rise along the St. Regis River

Reach No.	2000 Channel Sinuosity	1963-64 Channel Sinuosity	2000 Channel Slope	2000 Channel Vertical Rise
1	1.2	1.2	0.4%	85
2	1.1	1.1	0.4%	82
3	1.3	1.3	0.6%	159
4	1.2	1.1	0.5%	111
5	1.2	1.2	0.6%	125
6	1.1	1.1	0.8%	197
7	1.1	1.1	1.0%	236
8	1.2	1.2	1.6%	255
9	1.3	*	3.3%	593
10	1.3	*	8.0%	1,106
Mean	1.2	1.2	1.4%	2,949 total

* 1963-1964 aerial photographs were not available for these reaches.

Analysis of the Montana Department of Transportation construction plans for Interstate 90 provided further insight into the degree of channel alterations associated with this highway project. Overall, 14,700 feet (2.8 miles) of stream channel alterations resulted from the construction of Interstate 90, impacting 7% of the St. Regis River (**Table G-6**).
The Drexel East and West construction plans described 2,000 feet of channel alterations impacting 8% of Reach 3 upstream of Ward Creek. Construction plans also called for the addition of 51 boulder clusters to this reach using 570 cubic yards of riprap. The plans for DeBorgia East and West indicated channel alterations comprising 30% of Reach 5 along both sides of the river in the form of meander cutoffs along a 6,800-foot section extending from the Big Creek Road Bridge downstream past the confluence with Big Creek. Twelve hundred willow cuttings were also called for in this reach. Construction plans for upstream of Saltese described 3,600 feet of channel alterations at three sites in Reach 7 covering 15% of the reach, while 2,300 feet of channel alterations at two sites impact 14% of Reach 8, including an extensive section between the Rest Area and the Taft Exit. Construction plans called for over 11,000 willow cuttings and several jetties upstream of Saltese. These plans also described 550 feet of channel alterations made to Silver Creek just upstream of the confluence with the St. Regis River.

Table G-6. Stream channel alterations in Reaches 3, 5, 7, and 8 identified from the Montana Department of Transportation construction plans for Interstate 90

Reach No.	Reach Length (feet)	Length of Channel Alterations (feet)	%	No. of Sites
3	26,000	2,000	8	1
5	22,500	6,800	30	1
7	23,600	3,600	15	3
8	16,400	2,300	14	2
Total	210,500	*14,700*	*7*	*7*
	39.9 miles	2.8 miles		

Reach-Specific Descriptions

Reach 1 includes the St. Regis River from its confluence with the Clark Fork River upstream to Twomile Creek. The valley is open along this reach and is classified as a Valley Type 8 containing a meandering river with alluvial terraces and floodplains capable of producing a high sediment supply (Rosgen 1996). This 23,200-foot (4.4 mile) stretch of river has been heavily impacted by Interstate 90, which crosses the river four times on nine bridges. There are also four other bridge crossings, including FR 282 at Little Joe Creek and FR 431 at Twomile Creek. A total of 6,100 feet of riprap associated with Interstate 90 is located primarily along the left side of the river. The river runs between the East and West bound lanes for 5,200 feet, which includes 2,100 feet of riprap on river left and 1,200 feet of riprap along river right. There is also 2,200 feet of riprap associated with the railroad, which is located along the right side of the St. Regis River.

Reach 2 extends 19,300 feet (3.7 miles) along the St. Regis River from Twomile Creek upstream to Ward Creek. The river is naturally straight in a tight valley throughout this section, though Interstate 90 along river left and the railroad along river right confine the river channel further. This is a Valley Type 2, which tends to contain stable stream types and a low sediment supply (Rosgen 1996). However, extensive road cuts along the hill slopes above Interstate 90 may provide a significant source of sediment to this reach. The road cuts on the hillside are much deeper since the construction of Interstate 90 indicating that they cut into the hillside extensively during construction. There is 6,100 feet of riprap associated with Interstate 90, although 2,600 feet of the total appears to be remnants of Highway 10 riprap. Most of this (6,000 feet) is located along the left bank, while 100 feet are along right bank at one of the two Interstate 90 bridges that cross the river within this reach. There are also two U.S. Forest Service road bridges located at the upstream and downstream end of this reach. There is 2,500 feet of riprap along the river right bank associated with the railroad.

Reach 3 extends 26,000 feet (4.9 miles) from Ward Creek upstream to Twelvemile Creek. The river flows through a Valley Type 2 with larger meander curves than downstream (Rosgen 1996). This reach has been extensively impacted by the development of the transportation corridor. Channel condition is poor all the way down to Drexel. Channel alterations occurred between Drexel and Ward Creek during Interstate 90 construction. Road cuts are present along this reach as well. There are four Interstate 90 bridges in this reach and a 1,100-foot section in which the river is confined between the east and west bound lanes. Downstream of the Drexel Interchange (stations 45,100-47,400) there is extensive riprap in a 2,000 foot section resulting from a channel change involving the left bank of the river where it has been transformed into a straight canal. Boulder clusters were added in this section during the construction of Interstate 90. There is a total of 5,700 feet of riprap from Interstate 90 on river left and 300 feet of riprap on river right. There is an additional 5,800 feet of riprap associated with Highway 10 along river left for a total of 11,800 feet of riprap along the river left bank. There is 2,700 feet of riprap due to the railroad along the river right bank.

Reach 4 extends 23,000 feet (4.3 miles) from Twelvemile Creek upstream to Deer Creek. The St. Regis River is located to the south side of all roads and DeBorgia is on the river left side downstream of the Deer Creek confluence. The valley widens here and is considered a Valley Type 8 (Rosgen 1996). The river meanders though the valley and is relatively unconstricted from station 75,000 (mile 14.2) to 88,800 (mile 16.8), for a total of 13,000 feet (2.6 miles). Several

large logs were observed stranded on gravel bars in the aerial photographs. There are numerous roads on both hillsides and signs of recent timber harvest above the right bank were apparent in the 2000 aerial photos. There is 2,200 feet of riprap along the river right bank primarily resulting from construction of Highway 10 and the railroad, with only 300 feet attributed to the construction of Interstate 90. Most of the riprap is located at the downstream end of the reach directly above the Twelvemile Creek confluence. There are no Interstate 90 crossings in this reach, though a bridge on FR 236 leads up Deer Creek.

Reach 5 extends 22,500 feet (4.3 miles) from Deer Creek upstream to Haugan. Reach 5 ends just upstream of Haugan. The wide valley here is considered a Valley Type 8 (Rosgen 1996). This reach remains heavily impacted by Interstate 90, though there are no Interstate bridge crossings. The major impacts occur from just upstream of the Big Creek Road Bridge downstream past the confluence with Big Creek to the railroad bridge, where the St. Regis River meanders away from the Interstate. The impacted section of stream channel contains alterations totaling 6,800 feet (1.3 miles) long and containing riprap along both sides of the river. The riprap is set back from the channel along much of this reach to a width that appears to be at lest twice the bankfull channel width. Thus, the river meanders within an artificially straight channel formed by Interstate 90 along river left and the railroad on river right. There is some floodplain development evident within this channelized reach. There is also riprap along the outside of some of the meander bends contained within the wider riprapped channel. Immediate stream bank riprap within the channelized reach is addressed in this analysis. There is 5,400 feet of riprap close to or directly along the stream channel on river right bank and 1,600 feet of riprap along the river left bank that are associated with the channel change from Interstate 90 within Reach 5.

The Montana Department of Transportation plans for DeBorgia East and West contain a detailed description of planned channel change between the Big Creek Road Bridge, located across the river from the village of Haugan, and continuing downstream past the Big Creek confluence to the next railroad bridge. The impacted section of channel is 6,800 feet long and contains riprap along both sides of the river.

The St Regis River meanders through a broad gravel bar complex upstream of the Big Creek Road Bridge. This section may be aggraded due to the fact that this is the first place the river is allowed to spread out below the tightly confined upstream reach. Aggradation often occurs at the downstream end of channelized reaches as the slope decreases and excess sediment is deposited against the banks (Knighton 1998). There is an additional 1,400 feet of riprap associated with Interstate 90 along river right above the highly impacted section, with 1,100 feet of additional riprap along river left from the railroad. The broad nature of the river in this reach may be very susceptible to solar radiation leading to increased stream temperatures. A 7,000 (1.3 mile) portion of this reach (stations 104,500-111,500) may be a prime location for restoration efforts. The broad floodplain would allow room for more length to be added to the river, while the depth could be increased and a narrower tree-lined channel created that would help reduce thermal loading.

Reach 6 extends 24,500 feet (4.7 miles) from upstream of Haugan to upstream of Saltese. Interstate 90 crosses the St. Regis River twice in this reach, at the upstream and downstream boundaries of Saltese. The downstream portion of this reach is tightly confined in a Type 2

valley, while the upstream end of the reach, located just downstream of Saltese, is a wider Type 8 valley (Rosgen 1996). Road cuts on the hillside are evident in the Valley Type 2 portion of this reach and may be a significant source of sediment. The major impacts within this reach have resulted from railroad construction, with 5,600 feet of riprap along river left and 4,100 feet along river right, for a total of 9,700 feet. There is also 2,100 feet of riprap along river left and 200 feet along river right for a total of 2,300 feet of riprap associated with Interstate 90. Thus, 7,700 feet of the river left bank have been riprapped while 4,300 feet of right bank has been riprapped. There is a minimally impaired 2,500-foot (0.5 mile) section (stations 127,300-129,800) that may serve as an example of a minimally impacted reach to assist with reference development for the Valley Type 8 condition.

Reach 7 extends 23,600 feet (4.4 miles) from upstream of Saltese to Taft where the frontage road bridge crosses the St. Regis River. The Dominion Creek Road (FR 506) Bridge also crosses the river in this reach. The valley is a constricted Type 2 (Rosgen 1996). Road cuts are not quite as dramatic in this reach as in downstream reaches, though they still may be a significant source of sediment. Reach 7, which is highly impacted by both the railroad and the interstate, contains several channel alterations. There are 3,600 feet of channel alterations a three separate sites within a 10,600-foot section (2 mile) located directly upstream of the town of Saltese where the river now flows between the east and west bound lanes of I-90 (stations 138,500-149,100). There are 13,700 feet of riprap along this reach, with 7,100 along river left and 6,600 along river right. There is 4,300 feet of riprap from Interstate 90 along river left and 1,200 along river right. About 2,900 feet of the river left bank and 5,300 feet of the river right bank were riprapped during railroad construction.

Reach 8 extends 16,400 feet (3.1 miles) from Taft upstream to Hanakar Creek, which enters the St. Regis River directly downstream of the Interstate 90 bridge/culvert. The river flows through a Type 2 valley in this reach (Rosgen 1996). The St. Regis River has been altered by I-90 and extensively riprapped between the Rest Area and the Taft Exit for a distance of about 7,900 feet (1.5 miles), including 2,300 feet of channels alterations. The right bank is well vegetated with conifers that appear to provide a high degree of shade value. Just downstream of the I-90 Rest Area, there is an exposed hillside approximately 400 feet long (stations 167,000-167,400) which leads directly down to the right bank of the St. Regis River and which may be a significant sediment source. There is a total of 5,700 feet of riprap in this reach located entirely along the river left bank. Forty-two hundred feet of riprap are due to Interstate 90 and 1,500 feet of riprap are the result of railroad construction. The upper 1.6 miles of this reach contains a riparian area that may provide a good reference for the upper St. Regis River prior to the development of the transportation corridor, though there is still some interstate influence.

Reach 9 extends 18,200 feet (3.5 miles) from Hanakar Creek upstream to the old Northern Pacific railroad grade that crosses the St. Regis River. This reach flows through a Valley Type 5, which results from glacial scouring that creates wide U-shaped valleys containing streams with alluvial terraces and floodplains (Rosgen 1996). The lower portion of this reach is highly channelized including a 2000-foot section (0.4 mile) (stations 181,000-18300) that is confined by Interstate 90 on river right and a steep hillside supporting the old railroad along river left. There is a total of 5,400 feet of riprap in Reach 9, with 3,000 feet associated with the railroad along river left and 2,400 feet associated with the Interstate along river right. Upstream of the

channelized reach the river flows through a culvert, marking the most westward Interstate 90 crossing.

Reach 10 extends 13,800 feet (2.6 miles) from the old Northern Pacific railroad grade up to St. Regis Lake. The stream flows through a Type 5 valley in this reach (Rosgen 1996). This reach is not impacted by Interstate 90 or the railroads.

Conclusion

This assessment clearly confirms that the St. Regis River has been heavily impacted by stream bank alterations, channel encroachment, and channel alterations/shortening. This analysis indicates the presence of approximately 15.2 miles of riprap, with a total of 7.4 miles of riprap associated with Interstate 90 and 7.8 miles of riprap related to the construction and maintenance of Highway 10 and the railroads. Overall, approximately one-third of the entire 40-mile length of the St. Regis River has experienced stream bank alterations in the form of rock riprap placement along at least one of its stream banks. Reaches with greater than 25% of the streambanks impacted by rock riprap include Reach 3, which is between Twelvemile Creek and Ward Creek, and Reach 7, which is between Taft and Saltese.

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